

# FOSSIL FRUITING CONES OF *CASUARINA* AND *BANKSIA* FROM TERTIARY DEPOSITS IN VICTORIA

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## Abstract

A well preserved fruiting cone of *Casuarina* is recorded from the brown coal at Yallourn, Victoria. The cuticular structure of the individual fruits is described and comparisons are made with some living Victorian species of *Casuarina*.

Two fossil *Banksia* cones, collected from the Deep Leads at Eldorado, Victoria, are described and their cuticular structure is compared with that of a third fossil cone from Yallourn, Victoria.

FOSSIL FRUITING CONE OF *Casuarina*

Nat. Mus. Vic. No. P 15733.

(Plate I, figures 1-4)

## Introduction

A well preserved fruiting cone of *Casuarina*, now in the collections of the National Museum, Melbourne, was collected several years ago in the Yallourn Open Cut by the author and is the first record of its kind from this locality.

## Description

### *External Characters*

The specimen is a much compressed cone, measuring 2.2 cm. x 1.4 cm., and consists of small woody fruits, arranged in rows around a flattened axis. All the fruits are closed. Each fruit consists of two prominent valves, which are approximately 5 mm. broad and very slightly keeled; one or two retain the suggestion of a small mucro.

### *Cuticular Structure*

Several fragments of cuticle were removed from a valve, after treatment with Schultz's solution and alkali.

(1) OUTER EPIDERMIS. The epidermal cells vary in shape from rectangular to elongate-rectangular and have pitted lateral walls. They range in length from 18 to 29  $\mu$ . There is some evidence (Pl. I, fig. 3) that the cuticle is papillate, but the number of papillae per cell cannot be determined.

Some of the cells have the remains of hairs attached, consisting of two basal cells which measure 9 to 11  $\mu$  in diameter. In certain areas each epidermal cell supports a hair base, while in others the bases are entirely absent. Stomata occur in longitudinal rows in an area on the valve where there are many hair bases. Each stoma consists of two kidney-shaped guard cells which surround a small pore, approximately 2  $\mu$  long. The guard cells are heavily thickened at the junction of their ventral walls and on the dorsal walls. The polar diameter of the guard cells measures 11 to 16  $\mu$ . Associated with each stoma are two subsidiary cells, with pitted lateral walls, which lie parallel to the pore.

(2) INNER EPIDERMIS. The inner epidermal cells are more elongate than those of the outer epidermis, but neither stomata nor hair bases occur.

### Occurrence

The specimen was collected from a clay bed forming the floor (No. 3 level) of the Yallourn Open Cut, Victoria.

The deposit is believed to be of Oligocene age (Thomas and Baragwanath, 1950).

### CUTICULAR STRUCTURE OF THE VALVES OF LIVING SPECIES OF *Casuarina*

Preparations of cuticle from the fruiting cones of the following Victorian species were studied:

*C. cristata* Miq.; *C. Luehmanni* Baker; *C. Muelleriana* Miq.; *C. nana* Sieb. & Spreng.; *C. paludosa* Sieb. & Spreng.; *C. pusilla* Macklin; *C. stricta* Ait.; *C. suberosa* Otto & Ditt.

The structure of the epidermis is similar in all species examined; that of the inner and outer surfaces of each valve is distinct.

(1) OUTER EPIDERMIS. The epidermal cells are rectangular to elongate-rectangular and have thin, pitted lateral walls. The cuticle is distinctly papillate, there being approximately 20 to 30 papillae per cell, but sometimes these are fewer or even absent in areas surrounding the stomata (Pl. I, fig. 5).

The hairs and stomata are restricted to a definite zone (Fig. 1) just above the point of insertion of the valve on the woody axis. Each hair consists of two thin-walled basal cells and a long terminal cell which is often dichotomously branched (vide Solereder, 1908, p. 788, Fig. 186. E.D.). The diameter of the hair bases varies between species; measurements for those species examined are given in column I of Table 1.

The structure of the stomata is similar in all species examined (Fig. 2). The small pore, approximately  $2\ \mu$  in length, is surrounded by two kidney-shaped guard cells, which show a characteristic heavy thickening at the junction of the ventral walls and on the dorsal walls. This is attributed by Porsch (1905) to a deposit of cutin-lamellae in the cellulose membrane of these walls. Measurements of the average polar diameter of the guard cells in species examined are given in column II of Table 1. Each stoma is associated with two subsidiary cells having pitted lateral walls, which lie parallel to the opening of the pore.

TABLE 1

	1	2
<i>Casuarina cristata</i> .. ..	8	20
<i>Casuarina Luehmanni</i> .. ..	16	20
<i>Casuarina Muelleriana</i> .. ..	11	—
<i>Casuarina nana</i> .. ..	7	16
<i>Casuarina paludosa</i> .. ..	12	22
<i>Casuarina pusilla</i> .. ..	9	18
<i>Casuarina stricta</i> .. ..	18	20
<i>Casuarina suberosa</i> .. ..	12	20

1. Average diameter of the hair bases in  $\mu$ .

2. Average polar diameter of the guard cells in  $\mu$ .

(2) INNER EPIDERMIS. The epidermal cells are rectangular at the top of the valve, becoming more elongate towards the base. They have thick, pitted lateral walls but no cuticular papillae.

Numerous hairs form a dense mat which thins out towards the base, e.g. *C. stricta*, or is sometimes restricted to the uppermost portion of the valve, e.g. *C. suberosa*. In the upper region one hair per epidermal cell characterizes the

surface. The number of hairs diminishes towards the base, where they are entirely absent. The hairs are similar to those described and figured by Solereder (1908).

The stomata occur towards the tip of the valve, interspersed among the hair bases. Each stoma has the characteristic structure previously described for the outer epidermis.

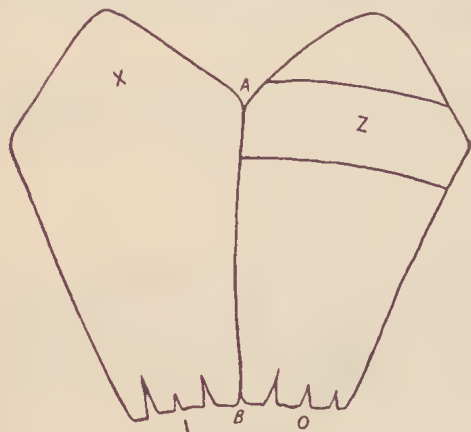


FIG. 1



FIG. 2

FIG. 1.—Diagram of cuticle from the inner and outer surfaces of a valve from a recent fruiting cone of *Casuarina*. AB, junction between inner and outer surfaces; X, area where stomata and hairs occur on inner surface, I; Z, zone where stomata and hairs occur in outer surface, O.

FIG. 2.—Camera lucida drawing of stoma of *Casuarina stricta*.  $\times 1450$ . G, guard cells; p, pore; s, subsidiary cells; t, thickening at junction of ventral walls of guard cells.

#### COMPARISON BETWEEN THE FOSSIL AND RECENT FRUITING CONES OF *Casuarina*

The resemblance in size, shape and structure between the fossil and recent fruiting cones of *Casuarina* leave little doubt regarding the generic identity of the Yallourn specimen. The cones of *C. stricta*, for example, have similarly ridged valves, while the mucro is obvious both before and after dehiscence.

The reference to *Casuarina* is completely confirmed by the similarities in cuticular structure between the fossil and living species. Cuticle removed from the valves of the fossil fruiting cone has epidermal structures which can be related to those of certain areas observed on the valves of living species. The structure of the stomata and hair bases is similar in both the fossil and recent species.

The differences in structure between the epidermal cells, stomata and hair bases are insufficient to distinguish between living species, thus the fossil cone cannot be assigned to, or compared with, a definite species.

#### *Previous Records of Casuarina from Victoria*

The only reference to *Casuarina* from Yallourn is by Cookson (1945) who noted the occurrence of fossil pollen grains in the brown coal deposits. Dr. R. T.

Patton, in a personal communication, has mentioned the presence of *Casuarina* wood.

Two earlier records of fossil cones from Victoria are based upon impressions. Patton (1936) described a *Casuarina* cone and branchlets, preserved as impressions in a siliceous sandstone, possibly of Miocene age, at Limestone Reserve, Parish of Yallock. He compared these specimens with the living Victorian species *C. glauca* Sieb., and *C. Cunninghamiana* Miq., on similarities in the size of the cones and the number of rudimentary leaves in a whorl.

Chapman (1914) examined impressions in a specimen of Newer Basalt from Yandoit Hill and compared them with plasticene impressions of the fruits of *C. stricta* Ait.

Other references to fossil remains of *Casuarina* from Victoria are based upon either shoots (Deane, 1904; Paterson, 1935) or wood (Armytage, 1910; Chapman, 1905, 1922; Gill and Baker, 1950).

## FOSSIL FRUITING CONES OF *Banksia* SPECIES

### Introduction

Two previously undescribed specimens (1 and 2) from Eldorado, Victoria, recognizable from external characters as fossil fruiting cones of *Banksia*, were lent for investigation by the National Museum of Victoria. Their description, given below, is based upon microscopic as well as macroscopic features, since the excellent state of preservation of the specimens permitted an examination of the cuticular structure of the capsules.

In addition, a fossil *Banksia* cone (Specimen 3) from Yallourn, Victoria, recorded by Cookson and Duigan (1950) has been re-examined and its cuticular structure compared with that of some living Victorian species and the Eldorado specimens.

### Description

#### SPECIMEN 1

Nat. Mus. Vic. No. P 15614

(Plate I, figure 6)

#### *External Characters*

The specimen is a large, complete cone, measuring 7.5 x 3.5 cm. It consists of numerous fertile capsules borne on a thick, flattened axis. The valves of the capsules are all closed, but in places where the edges have worn away, the seed is just visible.

#### *Cuticular Structure* (Fig. 3)

Fragments of cuticle removed from the outer surface of a capsule show polygonal epidermal cells, varying in diameter from 18 to 22  $\mu$ . They have thin, straight, unpitted walls, and hair bases occur, separated from each other by several cells. Each hair base is associated with two to four epidermal cells and measures 14 to 20  $\mu$  in diameter.

#### *Occurrence*

Deep Leads, Eldorado, Victoria. The specimen was collected from Tertiary gravels and the label "Bedrock level 200 ft." may indicate that it was found at that depth. Tertiary; exact age unknown.

## SPECIMEN 2

Nat. Mus. Vic. No. P 15615

(Plate I, figure 7)

*External Characters*

This specimen measures 4 x 2.5 cm. It is complete, excellently preserved, and consists of a series of thin capsules around a slightly flattened axis. Each capsule has two valves, which in many of the fruits are opened, exposing the seed. A high proportion of the fruits are fertile.

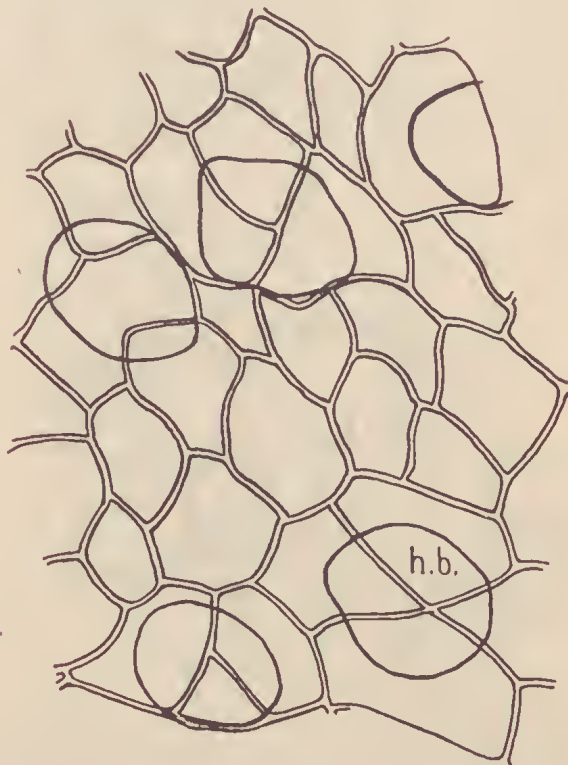


FIG. 3.—Camera lucida drawing, showing the epidermal structure of capsule of *Banksia* sp. Specimen No. 1, P.15614, Slide P.15735, Nat. Mus. Vic. x 600.

*Cuticular Structure* (Fig. 4)

The epidermal cells are small, polygonal, and measure 11 to 20  $\mu$  in diameter. Numerous hair bases characterize the surface. These range from 11 to 16  $\mu$  in diameter and each is associated with only one epidermal cell. In certain areas each cell supports a hair base while in others the bases are more widely separated.

*Occurrence*

Same locality and horizon as Specimen 1.

The cone from Eldorado, figured by Cookson and Duigan (1950, Pl. 7, fig. 49) is similar in size and external characters to this specimen. A comparison of the cuticles of the two cones suggests that they represent the same species.

## SPECIMEN 3

Nat. Mus. Vic. Nos. P 14743, 14775, 14776

Cookson and Duigan, 1950

Aust. J. Sci. Res. B. Vol. 3, Pt. 2, Pl. 7, fig. 52.

*External Characters*

This specimen has been figured and described by Cookson and Duigan (1950) as follows:— "The cone has been split longitudinally, and the apical region completely detached. The cone is 5.5 cm. long and 3 cm. wide, and its woody axis measures 5 mm. across. A large number of bracts and bracteoles, whose radial measurement is about 2 mm., are crowded on the axis and amongst them are suggestions of possible fruit valves." They were able to examine cuticle from the bracts of the Yallourn specimen and found that the hairs present were similar to those which occur on the bracts of the living species *B. integrifolia* and *B. marginata*.

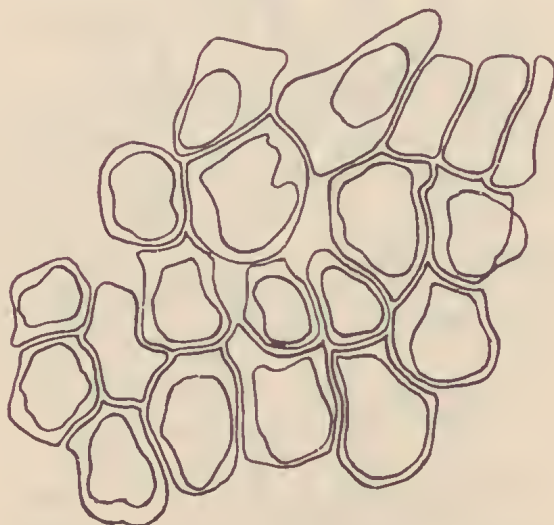


FIG. 4.—Camera lucida drawing, showing the epidermal structure of capsule of *Banksia* sp. Specimen No. 2, P.15615, Slide P.15736, Nat. Mus. Vic. x 600.

*Cuticular Structure of the Bracts* (Fig. 5)

The epidermal cells have much pitted, rather thick lateral walls, and measure 18 to 23  $\mu$  in diameter. Hair bases, with diameters between 21 and 25  $\mu$  are very numerous. There is usually one hair base to each cell.

*Occurrence*

In brown coal. Yallourn, probably from the Open Cut at Yallourn North, Victoria.

The deposit is probably Oligocene in age (Thomas and Baragwanath, 1950).

CUTICULAR STRUCTURE OF THE CAPSULES OF LIVING SPECIES OF *Banksia*

The following Victorian species have been studied: *B. collina* R. Br., *B. integrifolia* L., *B. marginata* Cav., *B. ornata* Muell., and *B. serrata* L.

An examination of the cuticle of these species revealed that the epidermal structure of the valves of the fruiting cones are essentially similar. The epidermal cells are small, polygonal, with thin lateral walls and no cuticular papillae. Delicate, thin walled hairs are present and are usually more numerous on the outer surface of the valves than on the inner. The hairs are always more dense towards the base of the capsule. Stomata occur on the outer surface of each valve and are present, but less numerous, towards the tip of the inner valve.

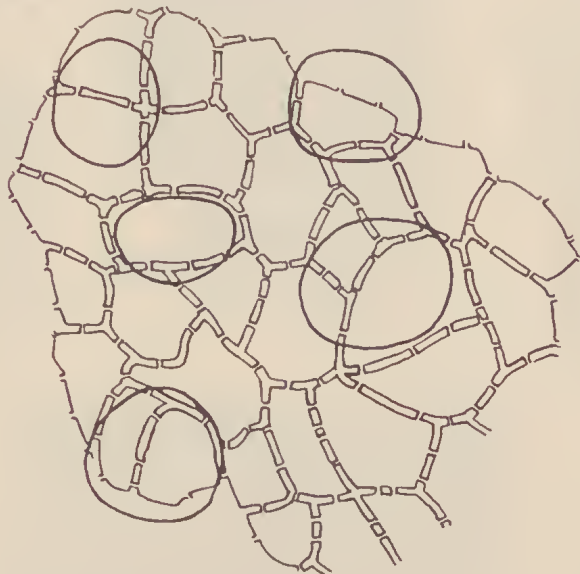


FIG. 5.—Camera lucida drawing, showing the epidermal structure of bract of *Banksia* sp. Specimen No. 3, P.14775, Slide P.15737, Nat. Mus. Vic., x 600, in an area where the hair bases are more widely separated than usual.

### Discussion

Although the two fossil *Banksia* cones from Eldorado differ in size, this is an insufficient basis for specific separation in view of the great variation in size shown within living species. The cones of *B. marginata*, for example, range in length from 3.5 to 10 cm., and a similar variation has been observed in *B. integrifolia*.

Since it is impossible to distinguish between the living species of *Banksia* examined, using the cuticular structure of the capsules of the fruiting cones, identification of a fossil cone by means of this character is impracticable. Hence, there is no justification for naming the two fossil cones from Eldorado.

The cuticular structure of the valves of Specimen 3 from Yallourn differs from that of the living species examined and the Eldorado specimens in having rather thick, much pitted cell walls and larger hair bases. These differences indicate that it may represent another species. Since six species of *Banksiaephyllum* leaves have been described from the brown coal at Yallourn (Cookson and Duigan, 1950) it is likely that this cone may belong to a species whose leaves have already been described. It seems desirable to wait until more complete evidence, afforded by the discovery of similar cones in association with leaves, is available before a specific name is given to this specimen.

*Previous Records from Victoria*

The first records of fossil fruiting cones of *Banksia* from Victoria by Redaway (1858) and Smyth (1873, 1875), refer to their occurrence in the deep leads.

Recently Cookson and Duigan (1950) have figured *Banksia* cones from Eldorado and Yallourn.

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**Explanation of Plate I**

- FIG. 1.—*Cosuarina* sp. Fruiting cone. Natural size. Yallourn, Victoria. Nat. Mus. reg. no. P.15733.
- FIG. 2.—The same specimen x 2.
- FIG. 3.—Cuticle from valve of *Cosuarina* sp. showing cuticular papillae. Yallourn. x 800. Nat. Mus. reg. no. P.15613.
- FIG. 4.—Another fragment showing stomata and hair bases. x 600. Same slide as figure 3.
- FIG. 5.—Cuticle from outer surface of valve of *Cosuarina stricta*, showing stomata, hair bases and cuticular papillae. x 600. Nat. Mus. reg. no. P.15734.
- FIG. 6.—*Banksia* sp. Specimen No. 1. Fruiting cone. Nat. size. Eldorado, Victoria. Nat. Mus. reg. no. P.15614.
- FIG. 7.—*Banksia* sp. Specimen No. 2. Fruiting cone. Nat. size. Eldorado, Victoria. Nat. Mus. reg. no. P.15615.